

department to know that you are on the job market. This can complicate your search in several ways. First of all, you may not feel comfortable asking for letters of recommendation from your department, which can rule out some of your best potential letter writers (especially for a teaching letter)! You should think over the summer about if there is someone in your department who will write for you and can keep a secret. Even if it's just a "citizenship" letter, it can be helpful to assuage the worst fears a hiring committee might have about why you are leaving. You do need a teaching letter, though, and in the worst case scenario you can ask whoever wrote for you for your current position to resubmit the letter. If you have no letters from your department, then definitely mention in your cover letter that you are keeping your search secret and for that reason you have not solicited any. This is also helpful to reduce the risk of someone who sees your application accidentally spilling the beans about the fact that you're on the job market.

Overall, don't worry too much—people switch tenure-track jobs all the time, and you will not be blacklisted in the mathematics community or in any sensible department for attempting to do so.

Good luck in your search!



Andrew Obus

Credits

Author photo is courtesy of Stephen Hardy.

Preparing for a Career at a Liberal Arts College

Julianna Tymoczko

I was asked how to prepare for a career at a liberal arts college. I want to start with disclaimers. First, I'm just giving my own perspective—I speak neither on behalf of Smith College nor on behalf of comparable liberal arts colleges around the country.

Second, there are a lot of different types of liberal arts colleges. Most faculty who thrive at places like Smith,

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Williams, Oberlin, Harvey Mudd, Mount Holyoke, etc., could be at R1 schools. However, there's a wide range in the amount of scholarship liberal arts colleges expect, and you should adjust my advice if you want a position at a different kind of liberal arts school. I find it useful to consider the baseline expectation to be that faculty teach four or five courses *per semester*. Academic institutions with research expectations reduce your teaching accordingly. For instance, a teaching load of two courses per semester means you're expected to spend about half your time on research. (To me, it seems most institutions expect service but have few metrics or incentives for performance or lack thereof.)

Finally, while the bulk of our work is with undergraduates, there is a substantial amount of postgraduate work at many of the strongest liberal arts colleges in the country, including a PhD program in math at Wesleyan, a combined BA/MA option as well as a PhD program at Bryn Mawr, and the postbaccalaureate program at Smith (which admits women who have completed an undergraduate degree and want to continue to graduate school but are not adequately prepared). A much larger group of liberal arts schools offers faculty the opportunity to supervise PhD candidates at an affiliated university. We also generally send a higher percentage of our graduates to STEM PhD programs than research universities, and this is a valued part of our institutional mission.

I'm going to give my advice backwards, starting where you'd like to end up (assessed favorably in your application) and moving back in time through a postdoc and to grad school.

The Application

Schools like Smith get around 800 applications for each tenure-track job. There are tons of highly qualified candidates. My list of features that help an application stand out overlaps with advice from a recent panel discussion printed in the *Notices* [1], but is specifically geared towards applications to schools with high research expectations.

Research Statement

We want this to be well thought out, giving a clear indication of future work (and why it matters) in the context of a track record of past work. We also want it to be independent, in the sense that the work could occur without our active supervision. In part, this is practical: liberal arts math departments are pretty small, and you likely won't have colleagues in your field at your school. Many liberal arts colleges are in rural locations where you may not even have colleagues in your field within an hour's drive.

As a corollary, your research statement is being read by mathematicians outside of your field. On the first page, give us a bird's-eye view of why anyone should be interested in your field: how does it connect to other parts of math? what are its main questions? where does your research fit into this big picture? (This is good advice for any job applicant, honestly.)

One final comment: essentially every application now includes the line “*plus I want to work with undergraduate students*” in their research statement. This is not compelling unless it is convincing: for instance, include any experience with undergraduate research, explain how to break down your work into problems that are approachable by undergraduates (literally list appropriate student problems!), and so on.

Teaching Statement

On some level, all good teaching has as its bedrock empathy, engaging and exciting students, and wanting to facilitate deep learning rather than parroting. Your job is to say this in a way that individuates you and gives a sense of how you, personally, teach. Statements that we like tend to be thoughtful, to show through the use of examples, and to have an awareness of different student audiences. They also show that you view teaching as a part of your long-term scholarly career: for instance, that you have plans building off of previous experiences, or that you’ve modified your teaching in response to partially flawed experiments.

There are lots of pedagogical buzzwords. You don’t need to teach in all those ways, though it can help to be aware of them—among other things, they can help you concisely describe your teaching style!

Concrete evidence and anecdotes typically make your teaching statement more vivid. Give examples of how you used project-based learning, or how you partially flipped your classroom, or how you led other unusual or innovative pedagogical activities in class. Past teaching evaluations can be useful. Zillions of pages of supplemental material that ostensibly require careful reading cannot.

One difference between liberal arts colleges and research universities is that we don’t specialize much in our teaching. In part, this is because we generally don’t have too many faculty; but also, appreciating a broad view of human knowledge and accomplishment is at the heart of the liberal arts mission. Can you teach most of the courses we offer? Most liberal arts schools only have limited opportunities to propose new classes. (Every math department everywhere is understaffed and overenrolled.) You can include classes you’d like to teach but don’t go crazy.

CV

This can include more than people sometimes think! List your mentoring, your organizing, your committees, all of your work with student researchers, every piece of scholarship you’ve authored or coauthored. Show us you have a professional passion by telling us what you’ve done in service of that goal.

Use formatting and spacing to make it easy for readers to navigate and to draw attention to the things you consider important (boldface/italics, paragraph breaks, bullet points and other list environments, figures, etc.). I believe that *all* liberal arts colleges are more appreciative of a range of scholarly activities than universities, from your math blog to your math art to your introductory number theory text.

Include *all of this work* in the scholarship section of your CV. If you feel you must break your research up into various topics (I’m not a fan), treat it with respect. If you devalue your own expository work, we may infer that you’ll devalue your colleagues’ expository work. Along these lines, all published research with students is research—if you want to highlight it, use asterisks or your research statement, not a “lesser work” section.

Diversity Statement

This is not a part of every application package. If you write one, use the evaluation rubric from UCal Berkeley as a how-to guide [2]. As with the teaching statement, describe your plans concretely, using specific examples of your past work to make it sound plausible. In particular, this is not a place to wax poetic about how you first discovered your white privilege.

Cover Letter

Some people may advise you that hiring committees do not look at cover letters. This is completely untrue for liberal arts colleges.² The main questions I want the cover letter to answer are: (1) Do you know what a liberal arts college is about? (2) Why do you want to be *here* in particular? In addition, give a thumbnail sketch of your accomplishments, even if they appear in other parts of the application. (This is also a place you can highlight your work towards a more inclusive mathematical community, especially if a diversity statement is not requested.)

Of course, you can knock it out of the park on every one of these points and still not get a Skype interview, because we don’t have the ability to interview everyone who knocks it out of the park. If you want to be here, though, apply again: apply even if you aren’t doing a broad job search, apply every year of your postdoc, apply even after you get another job—apply even if that job is at a different kind of institution.

How to Prepare to Write this Application

Working back from the application, what should you do to prepare for a job at a school like Smith? You can’t do everything at once; things take time. Expect to complete one (or even two) postdocs. The vast majority of the people we’ve interviewed in the last eight years have completed a postdoc. Every recent example I know where a peer institution hired straight out of grad school, the candidate deferred the start date to do a postdoc. That’s because a postdoc helps you develop the maturity, independence, perspective, and experience to thrive at our school.

Two clarifications: You don’t necessarily need a postdoc for a teaching-focused liberal arts college, but you’ll want to leave grad school able to independently produce a couple of papers for tenure, and fairly full-fledged as a teacher and

²Several friends who gave me feedback on a draft of this essay said I could not overemphasize the importance of the cover letter.

helpful department colleague. Also, I'd say a multiyear visiting position at a liberal arts college is a kind of postdoc, one that gives you experience in the culture and practice of work at a liberal arts college. For your best outcomes, the department should also limit your service obligations and mentor you in developing your professional portfolio.

At each step in this process, you'll learn how to do more better. You'll also learn how to do more worse: time management and abandoning perfectionism are two essential skills to develop before you get your job.

Research

Become independent! And an acknowledged expert in something! There are people who are narrow specialists, but part of the fun of working at a liberal arts college is doing something wildly out of your field—or changing field—or collaborating with a colleague in another department on something totally out of your expertise. In the big picture, you want some level of expertise and some level of flexibility.

You generally need roughly the same number of publications that you would be hired at an R1 job (which the chair of a big midwestern school told me is roughly—many caveats depending on field; don't hold me to this—around 7–8 if you've had three years of postdoc, including thesis). *For grad students:* If I were to quantify it, I'd say you want to leave grad school with one publication (more is fine; it can be undergraduate research or a project from an REU that you assisted; it doesn't need to be in your field), plus your thesis. Your first goal after getting your PhD is to turn your thesis into one or two papers. It helps to have some experience with the publication process before doing it alone.

Here's a dirty secret: unless one of us is in your field, we don't know the good journals in your field. We know the difference between conference proceedings and peer-reviewed journals, and we usually know the top journals across most fields. Don't stress about whether one journal or another is marginally better. Just publish!

Get involved with undergraduate research. This actually checks many boxes. First, any paper you've published with undergraduate coauthors is one more paper that you've published. Second, student-level projects are a way of obtaining and demonstrating some breadth. (They can also help give future you a roadmap for how to jump into a research project that's not your specialty.) Third, it can be challenging to work with student researchers, and it helps to start while someone senior is holding at least some of the reins.

There are lots of options in addition to helping out in national or regional REUs. Your institution likely has some sort of REU and/or opportunities for term-time work with students (either for money or for credit); some of your students have likely heard that research is good for them and are looking for it, even outside of an official program. (I'd tell grad students to get involved with an REU that someone

else is supervising before trying to lead research yourself.) Talk with more experienced faculty and look at books about student research before and during the process.³ You may need guidance to decide whether the outcome is publishable, especially if you aren't very familiar with journals oriented towards student research. You also may need guidance when writing a paper with undergraduates; it's very different from working with other colleagues, even graduate students. Through this process, you will learn a lot, and some of what you learn will surprise you.

Teaching

Right now, you have a golden opportunity to practice, learn about, and experiment with teaching: any failures won't be on your "permanent record" for a tenure evaluation, and will give you interesting experiences for a teaching statement (along the lines of "this thing didn't go well, and here's how I adapted and changed"). You have a few opportunities that you may not have again:

1. You have a teaching and learning center staffed by people who specialize in pedagogy, and possibly even some faculty who specialize in calculus or mathematics education.
2. Many graduate programs offer a teaching certificate or a graduate-school-wide course on teaching, and sometimes postdocs can participate.
3. Some people have extra time and energy (or want to end up at a teaching-focused institution); in this case, you can send your name and CV to local community colleges and other schools, gaining more teaching experience with a wider range of students.

To get a position at Smith, it's sufficient to be the instructor of record on at least one course (including in a coordinated calculus setting) in graduate school, assuming you teach more as a postdoc.

Aside from that specific training and experience, here are some guiding principles to help you choose your activities and manage your time.

- **Learn about pedagogical best practices, even if you don't do all of them.** Remember not to bite off more than you can chew: I've heard that you shouldn't change more than 10% of a course in any one semester, which accurately captures how much time and energy it takes to make what seem in the summer like minor changes. It doesn't seem an advantage on the job market to be a radical pedagogical experimenter—especially if your students

³A Mathematician's Practical Guide to Mentoring Undergraduate Research [3] gives an overview of the day-to-day challenges of supervising undergraduates. Directions for Mathematics Research Experience for Undergraduates [4] takes a more bird's-eye view, including different structures for running undergraduate research. The books in Birkhauser's series *Foundations for Undergraduate Research in Mathematics* introduce topics for undergraduate research, which can help you get a feel for the size, scope, and flavor of promising projects across a range of different mathematical fields.

hate you—though I don't see evidence that it hurts, if you can otherwise demonstrate effective teaching with reasonably satisfied students.

- **Practice communicating to all sorts of audiences.** Work on all sorts of communicating—writing, speaking, posters, pictures, semaphore, you name it—and all sorts of audiences. You can give research talks to specialists, an entire department, graduate students, or undergraduates. Give expository talks or public lectures, run a math circle for fifth-graders, work with a group of high school girls in math. Part of communicating well is writing: don't forget expository papers, blogs, opinion pieces, lecture notes, etc. Some opportunities may fall into your lap—seminar organizers invite you, or (if you're a graduate student) your advisor makes it happen. You can also invite yourself to give talks. Reach out especially to liberal arts colleges (near your graduate school, your home, your grandmother's home,...) and talk about something expository or some aspect of your research for an audience that (say) has no more background than linear algebra and multivariable calculus. You can repeat the same title/abstract multiple times; in fact, it's very common, and revising your talk will improve your math and your communication. You don't need to give a million talks in graduate school (5–10 over the course of your entire graduate career is great, especially if one is for undergraduates and you know it hits the mark). By the end of your postdoc, you should have an active record of public speaking in various venues.
- **Become broad.** If you're a theoretical mathematician, engage in a serious capacity with some aspect of statistics or applied math. You can be creative about how you do this—take a graduate-level course, help supervise an undergrad research project, work with students on the modeling competition, etc. (If you don't have computing experience, get some.) Be someone who can teach an introductory stats course if no specialists are available. If you are an applied mathematician, current educational trends mean you'll likely be swamped by students. Your goal is to have enough versatility so you don't feel trapped teaching the same three courses in the curriculum (emphasis on *trapped*, as in “not happy with the situation”). To do this—and to give future you more options to refresh yourself or move in different math directions—develop your capacity to teach midlevel transition courses. Depending on your preferences, this might mean taking graduate courses in or teaching analysis, calculus on manifolds, probability, combinatorics, possibly algebra. If your research isn't proof-oriented, consider TAing to establish your future credentials (including TAing for graduate courses).

Of course, it doesn't hurt to get teaching awards and high teaching evaluations.

Service

You want to work at a school that acknowledges it cares about students. (Of course this is true at universities, but it's often framed differently and underacknowledged.) You can't do everything and you should guard your time from service exploitation, but explore different activities to see what sorts of work resonates with you.

- **Find something that matters to you.** I'm prefacing this advice by urging you not to do too much, in the following sense. You don't get much credit on the job market for service. It's easy for this work to fall on a few people more than others (sometimes because they've already indicated they're interested in certain activities, which makes some faculty assume they're interested in all activities; other times because of implicit or explicit bias on the part of people delegating service tasks). There's also a certain kind of person who, when anxious about their own research or future, compensates by scrubbing the bathroom/organizing their closet/putting together the world's best grad-student-recruitment-weekend. If you are learning and especially *doing* math, then spend some time exploring service. Graduate school is a time to do a few things in a junior capacity—co-organize an event, mentor an undergraduate, run/help run a single session of a math club, attend events teaching you how to do service activities, etc.—and to gain a sense of what things there are out there to do. After a postdoc, we'd expect you to have more leadership experience: you might co-organize conferences or seminars, lead an REU, work with students from underrepresented groups in mathematics, write about math for popular audiences, bring math into political advocacy, or whatever else matters to you. As with research, find your niche and start establishing yourself.

A postdoc is a great time to learn more about academic institutional structures. You may be allowed to attend department and even college-wide faculty meetings; regardless, if asked, most faculty are willing to tell you how they think things run. It's worthwhile to hear how the sausage is made, because at a liberal arts college (and at most small departments), you'll be making the sausage soon after you arrive.

Two other pieces of advice are more general: meet colleagues at liberal arts colleges. Collaborate with them. Go to conferences at liberal arts schools (including undergraduate conferences). Cold-call people to ask about their job, how they like it, and how they prepared. This is not to get a job but to learn the culture, to become a known quantity, to get opinions and advice from people who are not me.

Finally, and it cannot be repeated too often, practice time management and setting realistic expectations for yourself. Work with the National Center for Faculty Development and Diversity (NCFDD), read the various books on academic productivity, get yourself some accountability and writing groups, build a supportive network of colleagues

and friends. Being an academic means being pulled in too many directions—by research, promotion requirements, student crises and successes, routine teaching, reports and memos and emails, perhaps even a personal life, and on top of it all, by your own enthusiasm and passion. The process of figuring out what matters and how to do it is lifelong and starts now.

There are no ruby slippers that will get you any one particular math job that you want. The steps I've outlined will get you a bunch of top ratings from our hiring committee—after that, there's a roll of cosmic dice. But the steps that I've outlined are also the process to a rewarding mathematical career: finding and doing the things that are meaningful to you, engaging deeply with students, and stretching your own intellectual limits.

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Author photo is courtesy of Smith College.

What to Expect at a Large Public Research University

David Jensen and Christopher Manon

A tenure-track position at an R1 public university will differ from other experiences in higher education in a few notable ways. Such positions typically have a greater focus on research productivity, and often have opportunities to integrate research into education. Teaching at a large public university also involves interacting with students from a wider range of educational backgrounds. We both have tenured positions at the University of Kentucky, and between us, we have attended and worked at several large, research-focused public universities, including the University of Texas, the University of Maryland, Stony Brook, and Berkeley. Departments at universities such as these share many commonalities.

Research

One of the major advantages of a research university is the existence of vertically integrated research communities. Our program has groups of graduate and undergraduate students, postdocs, and faculty at every stage of their career, all working in the same or related areas. All of these people interact mathematically to their mutual benefit. For example, tenure-stream professors have the opportunity to design and teach graduate classes and mentor PhD students. While the educational benefits of such opportunities are clear for the student, they also broaden and strengthen the research programs of the faculty. Similarly, research groups often run a seminar, bringing in speakers from all over the mathematical community, providing both students and faculty with a chance to learn about advances in mathematics beyond their own department. The give-and-take at seminars often leads to further developments and potential collaborations.

The central metric for evaluation, tenure, and promotion at an R1 is research, and often research productivity plays a role in decisions about salaries or teaching load. In order to help faculty meet these expectations, course loads are typically lower than at more teaching-focused institutions. (If a prospective employer tells you that they value research but that your teaching load will be 4–4, they are not telling you the whole truth.) Tenure-stream faculty are also expected to apply for research grants. This means that in addition to doing mathematics research, writing papers, planning and teaching classes, and the usual bout

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